International Research Journal of Natural and Applied Sciences
ISSN: (2349-4077)
Impact Factor- 5.46, Volume 5, Issue 4, April 2018
Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

A CASE STUDY OF SEASONAL OCCURRENCE OF *RHIZOSPHEREMYCOFLORA* ASSOCIATED WITH SELECTED PLANT SPECIES UNDER SOLID WASTE POLLUTION

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ABSTRACT

Most investigations of rhizosphere effects have been conducted at the scale of individual plants, however, and as a result, the ecological significance of these effects is poorly understood. Moreover, recent studies suggest that rhizosphere processes may play a central role in mediating ecosystem feed backs to climate change through their effect on net primary production, decomposition and storage (Cheng and Kuzyakov, 2005; Phillips, 2007). Many anthropogenic activities such as city development, agriculture, use of pesticides and pollution can potentially affect soil micro diversity(Forney et.al. 2004). Soils under pollution stress can maintain microbial activity because sensitive microbial communities can be replaced by more tolerant ones. Changes in microbial communities structure were observed in a long term studies (Macdonalds et.al., 2007). During the present study, seasonal occurrence of rhizosphere mycoflora associated with selected plant species growing under Solid Waste Pollution, were investigated through microbial ecological techniques. The distribution patterns of fungal isolates, based on their percentage occurrence were determined. Further pollution indicator fungi are being identified. The present studies indicated the role of various ecological factors, stress due to presence of SWP in the soil samples investigated, interaction between individual selected plant species and its rhizosphere fungal community ultimately decided the existence, survival of fungal isolates, in various seasons. Some of them

i.e. Aspergillus niger, Absidia glauca, Rhizopus nigricans and Trichoderma koningi are recognized as pollution indicators.

Keywords: Solid waste pollution, rhizosphere effects, anthropogenic activities, microbial communities, pollution indicators

Introduction

Soil is a rich habitat for the growth of microorganisms than other microbial habitats, among these microorganisms; fungi are one of the dominant groups present in the soil. Fungi live multiply and die or disintegrate in the soil and thus they provide rich organic matter, which could be recycled as plant nutrition. A high diversity of microorganisms has been identified to have deleterious, beneficial or neutral effects on plants (Nannipieri *et. al*., 2003). Microorganisms present in the rhizosphere play important roles in ecological fitness of their plant host (Kent *et.al.,* 2002). The importance increased in highly populated and industrialized areas because of their high organic and inorganic contamination, considerable impacting microbial communities. Microbial diversity indices can function as bioindicators of community stability and impact of anthropogenic stress on soil biota. Microorganisms (microbial diversity) describe complexity and variability at different levels of biological organization (Kumarerer, 2004). Metal and metalloid concentrations in soil exert an enormous influence on the diversity, composition and activity of soil, micro-organisms that carry out essential ecosystem service. At high concentrations, the toxic effects of metals result in reduced microbial diversity and alter rates of key biological process that underlie ecosystem functions. Toxicities are particularly influenced by physico-chemical conditions in soils that influence the bioavailability of metal and metalloids to plants and microorganisms (Crowley, 2008). High concentration of metals can impact soil quality and soil health; largely a result of the negative effects of metals on soil microbes. Metal contamination has been shown to decrease soil microbial biomass (Tandy *et.al.,* 2005) and activity (Smolders, 2004). Soil mechanisms respond rapidly to anthropogenic disturbances (Acosta- Martinez *et.al*., 2008; Shishido *et.al.,* 2008). Hence they adapt to environmental conditions and the microbial communities that are the best adapted will be most dominant (Nielsen, 2002).

Materials & Methods

Collection of soil samples from selected areas under solid waste pollution

One gram of each of soil samples were obtained from two inches depth of soil near the root zone of selected plant species growing in the selected areas under solid waste pollution similarly samples were obtained from root zone of selected plant species under normal conditions for control purpose. All the samples were scooped into presterilized Individual polythene bags separately and were brought to the lab for study in rhizosphere mycoflora associated with selected plant species.

Isolation of Rhizosphere Mycoflora through "Warcup's soil plate method"

i. Preparation of basal medium

Potato-Dextrose Agar (PDA) medium was employed as the basal medium which contained the following composition per liter of distilled water:

Potato	–	200gms
Dextrose	–	15gms
Agar	–	20gms

The pH of the medium was adjusted to 7.0 before sterilization. The contents were taken into 1000 ml of Erlenmeyer flask and sterilized for 15-20 minutes at 15 lbs pressure. Under aseptic conditions, adopting Warcup's soil plate method (1950), the soil samples were spread on the surface of the presterilized petriplates, into which medium was poured. The culture plates were incubated for about 8-10 days at 28^0C to obtain pure fungal cultures. Duplicate sets of plates were run for each soil type as well as for control sets.

ii. Purification and Maintenance of fungal isolates through conventional mycological techniques

After ensuring optimum growth, the mycelial fragments obtained from the margins of the growing fungal colonies were picked up by the sterilized inoculation needle and were transferred aseptically into sets of Petriplates containing PDA medium as well as in the

borosil culture tubes for obtaining pure isolates as well as culture tube slants in order to maintain pure cultures. They were incubated for 8-10 days at 28^0C. After obtaining a fairly good growth, they were preserved in the refrigerator. Periodically, the cultures were transferred into fresh tubes and were examined for their purity and progress from time to time. A duplicate of each isolate was cultured and maintained.

To ascertain seasonal occurrence of rhizosphere mycoflora

In order to ascertain seasonal occurrence of rhizosphere mycoflora, soil samples obtained in summer, rainy and winter seasons in the rhizosphere zone of selected plant species growing in selected areas under polluted conditions as well as from normal conditions were employed for isolating fungi by adopting "Warcup's soil plate method", further the fungal isolates were purified, maintained and identified.

To identify fungal isolates as pollution indicators

Among the fungal isolates, those that occurred frequently in the rhizosphere mycoflora of selected plant species growing under SWP condition were observed and recorded as pollution indicators (Table:1-5).

Results

Table: 1. Seasonal occurrence of fungal isolates in the rhizosphere of *Acalyphaindica*

S. No	Name of fungal species	A						B						C						D						E					
		S		R		W		S		R		W		S		R		W		S		R		W		S		R		W	
		C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T
1.	*Absidia glauca*	+	+	+	-	+	+	+	+	-	+	-	-	+	-	+	-	+	+	+	+	+	+	+	+	+	-	+	-	+	+
2.	*Aspergillus flavus*	+	-	-	-	+	-	+	-	+	-	+	-	+	+	+	-	-	-	+	-	+	-	+	-	-	-	-	-	+	-
3.	*Aspergillus fumigates*	+	+	+	-	-	-	+	-	+	-	+	+	-	+	-	+	+	-	+	+	+	-	-	-	+	-	+	-	+	+
4.	*Aspergillus niger*	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	+	+	-	-	+	+	+	+	+	-	+	+
5.	*Aspergillus ustus*	-	+	+	-	+	-	-	+	-	-	+	-	+	-	+	-	+	-	+	+	+	+	+	+	-	+	-	-	+	+
6.	*Botrytris terestris*	+	-	+	+	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
7.	*Curvularia lunata*	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	+	-	+	+	-	-	-	-	-	-	-	-	-	+
8.	*Fusarium oxysporum*	+	+	-	+	-	-	-	-	-	+	-	-	-	-	+	-	-	-	+	-	+	-	-	-	+	+	+	-	-	-
9.	*Fusarium lateritium*	-	-	+	-	+	+	-	-	+	+	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	+
10	*Geotrichum*	-	+	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	+	-

.	*candidum*																													
11.	*Helminthosporium sp.*	+	-	+	-	-	-	-	-	-	-	-	-	+	+	-	+	+	+	-	+	+	-	-	-	+	-	-	+	-	-
12.	*Mucor globosus*	+	+	+	+	-	-	+	-	-	-	+	+	-	-	-	-	-	-	+	-	+	-	-	-	+	-	-	-	-	-
13.	*Mucor racemosus*	+	-	-	-	+	-	+	-	+	-	-	-	+	-	-	-	-	+	+	+	+	+	+	+	-	-	+	-	+	+
14.	*Penicillium sp.*	-	+	-	+	-	+	+	-	+	+	+	+	-	-	+	-	-	-	+	+	+	+	-	-	+	+	-	-	-	-
15.	*Rhizopus globosus*	+	-	+	-	+	+	-	+	+	-	-	+	+	+	-	-	+	-	-	+	-	-	+	-	-	-	+	+	+	-
16.	*Rhizopus nigricans*	+	+	-	+	-	+	-	-	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	-	+	+	-	-
17.	*Trichoderma koningi*	-	+	+	-	-	-	-	-	-	+	+	-	+	+	-	+	-	-	+	+	-	+	+	+	+	+	+	+	+	+
	Total no. of species	**11**	**10**	**10**	**6**	**8**	**7**	**7**	**3**	**8**	**7**	**10**	**7**	**10**	**7**	**7**	**5**	**8**	**3**	**13**	**12**	**10**	**6**	**8**	**6**	**8**	**5**	**9**	**5**	**10**	**9**
% Frequency occurrence		**64.70**	**58.52**	**58.52**	**35.29**	**47.05**	**41.76**	**41.76**	**17.64**	**47.05**	**41.76**	**58.52**	**41.76**	**58.52**	**41.76**	**58.52**	**41.76**	**41.76**	**29.41**	**47.05**	**17.64**	**76.47**	**70.58**	**58.52**	**35.29**	**47.05**	**35.29**	**47.05**	**29.41**	**52.94**	**29.41**

A = Old Vijay Nagar Market (Commercial Sector), B = Shaheed Nagar (Residential Sector), C = St. Francis School (Public Sector), D = Naval Kishore Hospital (Hospital Sector), E = ISBT Bus Stand (Industrial Sector)

(+) = Present, (-) = Absent

Table: 2. Seasonal occurrence of fungal isolates in the rhizosphere of *Calotropisprocera*

S. No	Name of fungal species	A						B						C						D						E					
		S		R		W		S		R		W		S		R		W		S		R		W		S		R		W	
		C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T
1.	*Absidiaglauca*	+	+	-	+	+	+	+	-	+	+	+	+	-	-	-	-	+	+	-	-	+	-	+	+	-	-	+	+	-	-
2.	*Aspergillusflavus*	+	+	+	+	+	-	+	-	+	+	+	-	+	+	+	+	+	-	+	-	+	-	-	-	+	-	-	-	+	+
3.	*Aspergillusfumigatus*	+	-	-	-	+	+	+	-	-	-	+	+	-	-	+	+	-	-	+	-	-	-	+	-	+	+	-	-	+	-
4.	*Aspergillusniger*	+	-	+	+	+	+	+	+	+	+	+	-	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5.	*Aspergillususstus*	-	-	+	-	-	-	+	+	-	-	-	+	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
6.	*Botrytristerestris*	+	-	-	-	-	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	+
7.	*Curvularialunata*	-	-	+	-	+	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	+	-	-	-	+	+
8.	*Fusariumoxysporum*	-	-	-	-	+	-	+	+	+	+	+	+	-	-	-	-	-	+	+	-	-	-	-	-	+	-	-	-	-	-
9.	*Fusariumlateritiu*	+	+	-	-	+	-	-	-	-	-	+	+	+	-	+	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-

	m																													
10.	***Geotrichumcandidum***	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	+	+	-	+	+	+	-	-	+	-	-	-	-
11.	***Helminthosporium sp.***	+	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
12.	***Mucorglobosus***	+	-	+	+	-	+	+	-	+	-	+	-	+	-	-	-	+	-	-	-	+	-	-	+	-	-	+	-	+	+
13.	***Mucorracemosus***	+	-	+	-	+	+	-	-	+	+	+	+	+	-	+	+	-	-	+	-	+	-	+	-	-	-	+	-	+	-
14.	***Penicillium sp.***	-	-	+	-	-	+	+	+	-	-	-	+	-	-	-	-	-	-	-	+	+	-	-	+	-	+	-	+	-	-
15.	***Rhizopusglobosus***	-	+	+	+	+	-	+	+	-	-	+	+	+	-	+	-	+	-	+	-	+	+	-	+	+	-	-	-	+	+
16.	***Rhizopusnigricans***	+	+	-	-	+	+	+	+	+	+	+	-	-	+	-	+	-	-	+	+	+	+	+	-	-	-	+	+	+	-
17.	***Trichodermakoningi***	+	+	-	-	+	-	+	-	-	-	-	-	+	-	+	+	-	-	-	-	+	+	-	+	+	+	-	-	+	+
	Total no. of species	**11**	**7**	**9**	**5**	**12**	**9**	**13**	**6**	**8**	**7**	**11**	**7**	**7**	**4**	**8**	**6**	**6**	**4**	**8**	**4**	**11**	**5**	**7**	**5**	**9**	**5**	**7**	**4**	**9**	**7**

% Frequencyoccurrence	64.70	41.76	52.94	29.41	70.58	52.94	76.47	35.29	47.05	41.76	64.70	41.76	41.76	23.52	47.05	35.29	35.29	23.52	47.05	23.52	64.70	29.41	41.76	29.41	52.94	29.41	41.76	23.52	52.94	41.76

A = Old Vijay Nagar Market (Commercial Sector), B = Shaheed Nagar (Residential Sector), C = St. Francis School (Public Sector), D = Naval Kishore Hospital (Hospital Sector), E = ISBT Bus Stand (Industrial Sector)

(+) = Present, (-) = Absent

Table: 3. Seasonal occurrence of fungal isolates in the rhizosphere of *Cannabis sativa*

S. No	Name of fungal species	A						B						C						D						E					
		S		R		W		S		R		W		S		R		W		S		R		W		S		R		W	
		C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T
1.	*Absidiaglauca*	+	+	-	+	+	+	+	-	+	-	+	-	+	+	-	+	-	-	+	+	+	+	-	-	+	+	-	-	-	-
2.	*Aspergillusflavus*	+	+	+	-	+	-	+	+	+	-	-	+	+	+	+	-	+	-	+	-	-	-	+	-	+	-	-	-	+	+
3.	*Aspergillusfumigatus*	+	+	+	+	-	-	+	+	+	-	+	-	+	-	-	-	+	-	+	-	+	+	-	-	-	-	+	-	+	-
4.	*Aspergillusniger*	+	+	+	-	+	+	-	+	+	+	+	-	+	-	+	+	-	+	+	+	-	-	+	+	-	-	+	+	+	-
5.	*Aspergillususstus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	+	+	+	-	-	-	+	+	-	+	+	+
6.	*Botrytristerestris*	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
7.	*Curvularialunata*	-	-	-	-	+	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

8.	***Fusariumoxysporum***	+	+	+	-	+	+	-	-	+	+	+	+	+	+	+	+	-	+	-	-	+	-	-	-	+	-	+	-	-	+
9.	***Fusariumlateritium***	-	+	+	-	-	-	+	-	-	+	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
10.	***Geotrichumcandidum***	-	-	-	-	+	-	-	-	+	+	-	-	-	-	+	+	-	-	-	-	-	-	-	-	+	+	-	+	-	+
11.	***Helminthosporium sp.***	-	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-	-	+	-	-
12.	***Mucorglobosus***	+	+	+	+	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	+	+	-	+	-	-	+	-
13.	***Mucorracemosus***	+	-	+	-	-	-	+	+	-	-	+	-	-	-	+	-	+	+	-	+	-	+	-	-	+	-	+	-	+	+
14.	***Penicillium sp.***	+	-	-	-	+	+	-	-	+	-	+	+	-	-	-	-	-	-	-	-	+	+	+	+	+	-	+	-	-	-
15.	***Rhizopusglobosus***	-	-	+	+	-	+	+	-	-	-	-	-	+	-	-	-	+	+	+	+	-	-	-	-	-	-	+	+	-	-
16.	***Rhizopusnigricans***	+	-	+	-	+	+	+	+	-	-	-	-	-	+	+	+	-	+	+	-	+	+	+	+	+	+	-	-	+	-
17.	***Trichodermakoningi***	+	-	-	-	+	+	-	+	-	-	-	-	-	-	-	+	+	-	-	-	+	+	+	-	+	+	-	-	+	+

	Total no. of species	**11**	**8**	**9**	**5**	**10**	**9**	**7**	**6**	**8**	**5**	**6**	**3**	**6**	**5**	**8**	**6**	**7**	**5**	**8**	**6**	**8**	**7**	**6**	**4**	**9**	**7**	**6**	**5**	**8**	**6**
% Frequencyoccurrence		**64.70**	**47.05**	**52.94**	**29.41**	**58.52**	**52.94**	**41.76**	**35.29**	**47.05**	**29.41**	**35.29**	**17.64**	**35.29**	**29.41**	**47.05**	**35.29**	**41.76**	**29.41**	**47.05**	**35.29**	**47.05**	**41.76**	**35.29**	**23.52**	**52.94**	**41.76**	**35.29**	**29.41**	**47.05**	**35.29**

A = Old Vijay Nagar Market (Commercial Sector), B = Shaheed Nagar (Residential Sector), C = St. Francis School (Public Sector), D = Naval Kishore Hospital (Hospital Sector), E = ISBT Bus Stand (Industrial Sector)

(+) = Present, (-) = Absent

Table: 4. Seasonal occurrence of fungal isolates in the rhizosphere of *Croton Bonplandianum*

S. No	**Name of fungal species**	**A**						**B**						**C**						**D**						**E**					
		S		**R**		**W**		**S**		**R**		**W**		**S**		**R**		**W**		**S**		**R**		**W**		**S**		**R**		**W**	
		C	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**
1.	***Absidiaglauca***	+	+	+	+	+	-	-	-	-	-	+	-	+	+	-	-	+	-	-	+	+	+	-	-	+	-	+	+	-	-
2.	***Aspergillusflavus***	+	+	-	+	+	+	+	+	-	+	+	+	+	-	-	-	-	+	+	-	+	-	+	+	+	-	-	-	-	+
3.	***Aspergillusfumigatus***	+	+	+	-	+	-	+	-	+	-	-	-	+	+	-	-	+	+	+	-	-	-	+	-	+	-	-	-	+	-
4.	***Aspergillusniger***	+	-	+	+	+	+	-	+	+	+	+	-	-	-	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	-
5.	***Aspergillususstus***	-	+	+	-	+	-	-	-	+	-	-	-	+	-	-	+	-	+	+	-	+	+	-	-	+	-	+	+	+	+

6.	***Botrytristerestris***	-	-	+	+	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-
7.	***Curvularialunata***	+	+	-	+	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
8.	***Fusariumoxysporum***	+	+	+	-	+	+	+	+	-	-	-	+	-	-	+	-	+	-	+	-	+	+	-	-	+	+	+	+	+	-
9.	***Fusariumlateritium***	+	+	-	-	+	-	-	-	+	+	-	-	-	+	-	-	-	-	+	-	+	-	+	-	-	-	-	-	-	-
10.	***Geotrichumcandidum***	+	-	+	-	+	-	+	+	-	-	+	-	+	-	-	-	+	+	-	+	-	-	+	+	+	+	+	+	+	+
11.	***Helminthosporium sp.***	-	-	+	-	-	-	-	-	+	+	-	-	+	-	+	+	+	+	+	-	+	-	-	-	+	-	-	-	-	-
12.	***Mucorglobosus***	+	-	+	-	+	+	+	+	-	+	-	+	-	-	+	+	+	-	-	+	-	+	+	-	-	+	+	+	+	-
13.	***Mucorracemosus***	+	+	+	+	+	+	+	-	+	-	+	-	-	+	-	+	+	-	+	+	+	-	+	+	+	-	+	-	-	-
14.	***Penicillium sp.***	+	+	-	-	+	+	+	+	-	-	-	+	+	-	+	-	+	-	-	-	+	-	+	+	+	-	+	+	+	-
15.	***Rhizopusglobosus***	+	+	+	+	-	+	-	+	+	-	+	-	+	-	+	-	+	+	+	+	-	-	-	-	+	+	-	-	+	+
16.	***Rhizopusnigricans***	+	+	+	+	+	+	+	-	+	+	-	-	-	+	-	-	+	-	+	-	+	+	+	+	-	-	+	+	+	+

17.	***Trichodermakoningi***	-	+	-	-	+	+	+	-	-	-	+	-	-	-	+	-	+	+	+	-	-	-	+	-	+	+	+	+	-	-
	Total no. of species	**13**	**12**	**12**	**8**	**13**	**9**	**10**	**7**	**9**	**6**	**6**	**4**	**9**	**5**	**8**	**5**	**12**	**8**	**10**	**7**	**10**	**6**	**11**	**6**	**11**	**6**	**11**	**9**	**9**	**5**
% Frequencyoccurrence		**76.47**	**70.58**	**70.58**	**47.05**	**76.47**	**52.94**	**58.52**	**41.76**	**52.94**	**35.29**	**35.29**	**23.52**	**52.94**	**29.41**	**47.05**	**29.41**	**70.58**	**70.58**	**47.05**	**58.52**	**41.76**	**58.52**	**35.29**	**64.70**	**35.29**	**64.70**	**52.94**	**52.94**	**52.94**	**29.41**

A = Old Vijay Nagar Market (Commercial Sector), B = Shaheed Nagar (Residential Sector), C = St. Francis School (Public Sector),

D = Naval Kishore Hospital (Hospital Sector), E = ISBT Bus Stand (Industrial Sector)

(+) = Present, (-) = Absent

Table: 5. Seasonal occurrence of fungal isolates in the rhizosphere of *DaturaStramonium*

S. No	**Name of fungal species**	**A**						**B**						**C**						**D**						**E**					
		S		**R**		**W**		**S**		**R**		**W**		**S**		**R**		**W**		**S**		**R**		**W**		**S**		**R**		**W**	
		C	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**	**C**	**T**
1.	***Absidiaglauca***	+	+	+	-	+	+	-	-	-	-	+	-	+	+	+	-	+	-	+	+	-	-	-	-	+	-	-	-	+	+
2.	***Aspergillusflavus***	+	+	+	+	-	-	+	+	+	+	+	+	+	-	+	-	+	+	+	+	-	+	-	-	-	-	+	-	+	-
3.	***Aspergillusfumigatus***	+	+	+	-	-	+	-	-	+	+	+	+	+	+	+	-	-	-	+	-	+	-	+	-	+	-	+	-	-	+
4.	***Aspergillusniger***	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	-	+	+	+	+	+	+	+	-	+	+	+	+	+

5.	***Aspergillususstus***	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	+	-	+	-	-	+
6.	***Botrytristerestris***	+	+	-	+	+	-	+	-	-	-	+	-	-	-	-	-	+	-	+	+	-	-	-	-	-	-	+	-	-
7.	***Curvularialunata***	+	+	+	+	-	+	-	+	-	-	+	-	-	-	-	-	+	-	-	-	+	-	-	+	+	+	-	+	+	-
8.	***Fusariumoxysporum***	-	+	-	+	+	+	-	-	+	+	-	-	+	-	+	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-
9.	***Fusariumlateritium***	+	-	+	+	+	-	-	-	-	-	+	+	-	-	-	-	+	+	+	-	-	+	-	-	+	+	-	-	-	-
10.	***Geotrichumcandidum***	+	-	+	-	+	-	+	+	-	-	-	-	+	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	+
11.	***Helminthosporium sp.***	-	+	-	-	-	+	+	+	-	-	+	-	-	-	-	-	-	-	+	-	+	+	+	-	-	+	-	-	+	+
12.	***Mucorglobosus***	+	-	+	+	+	-	+	-	-	-	-	-	+	-	+	+	+	+	-	+	-	-	-	-	-	-	+	-	+	-
13.	***Mucorracemosus***	+	+	+	+	+	-	-	+	-	+	+	+	-	-	+	-	-	-	+	-	+	-	+	-	+	-	-	+	+	-
14.	***Penicillium sp.***	+	+	+	+	+	+	+	-	-	-	-	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	+
15.	***Rhizopusglobosus***	+	-	+	-	+	-	-	-	+	-	-	+	+	+	-	-	+	+	-	-	-	-	+	+	-	-	-	-	-	-
16.	***Rhizopusnigricans***	-	+	+	+	-	+	+	-	-	-	+	-	+	+	-	+	+	+	+	-	+	-	-	-	-	-	-	+	+	-
17.	***Trichodermakoningi***	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	-	-	+	-	+	+	+	+	+	+	+	+	-	+	-

	Total no. of species	**14**	**12**	**13**	**11**	**12**	**8**	**9**	**7**	**6**	**5**	**11**	**6**	**10**	**7**	**8**	**4**	**10**	**7**	**10**	**8**	**8**	**5**	**6**	**4**	**7**	**5**	**7**	**5**	**9**	**7**
% Frequency occurrence		**82.**	**70.**	**76.**	**64.**	**70.**	**47.**	**52.**	**41.**	**35.**	**29.**	**64.**	**35.**	**58.**	**41.**	**47.**	**23.**	**58.**	**41.**	**58.**	**47.**	**47.**	**29.**	**35.**	**23.**	**41.**	**29.**	**41.**	**29.**	**52.**	**41.**

A = Old Vijay Nagar Market (Commercial Sector), B = Shaheed Nagar (Residential Sector), C = St. Francis School (Public Sector), D = Naval Kishore Hospital (Hospital Sector), E = ISBT Bus Stand (Industrial Sector)

(+) = Present, (-) = Absent

Discussion

During the present study the soil samples from rhizosphere zone are collected from selected plant species growing in selected areas of Agra city about 17 fungal isolates i.e. *Absidiaglauca, Aspergillus flavus, Aspergillus fumigatus , Aspergillus niger, Aspergillus ustus, Botrytis terrestris, Curvularia lunata, Fusarium oxysporum, Fusarium lateritium, Geotrichum candidum, Helminthosporium, Mucor globosus, Mucor racemosus, Penicillium daleae, Rhizopus globosus, Rhizopus nigricans* and *Trichoderma koningi* were isolated through standard mycopathological techniques and identified with the help of standard manuals. In the rhizosphere of all the plants studied under control conditions, percentage frequency of fungal isolates from normal conditions is compared with that of treated (SWP) conditions observed to be more than that of treated conditions. Seasonal occurrence of fungal isolate was further among the seasons summer season supported occurrence of more fungal isolates. Among the plants investigated *Datura stramonium* showed maximum fungal isolates under control conditions in its rhizosphere during summer in comparison to the rest of the plants. The observations recorded on seasonal occurrence of fungal isolates revealed, the role of eco-environment, monitoring fungal populations associated with rhizosphere of individual plant species. Their presence or absence in the rhizosphere zone in selected plant species growing under polluted habitats indicated the adverse effects of soil pollutants on the presence and absence of fungal isolates studied.Fungal isolates such as *Aspergillus niger, Absidia glauca, Rhizopus nigricans* and *Trichoderma koningi* commonly found under treated conditions due to their abilities to with stand solid waste polluted conditions can be treated as pollution indicators (Table:1-5)

Microbial communities can adapt to metal pollution but loss of species diversity results in potential losses of biological functions and reduce soil resilience. It is concluded that micro-organisms appear to be excellent indicators of soil health because they respond quickly to changes in the soil ecosystem and have intimate relations with their surroundings due to their high surface to volume ratio. Micro-organisms as indicators of environmental impacts in soil monitoring is the objective of the EV cost action 831, a co-operative project by scientist (Nielsen, 2002). *Curvularia* and *Fusarium*, known as common in agricultural soils, are more sensitive to metals than other fungi (Amie and Pineau, 1998). The genera *Aspergillus*,

Rhizopus, Penicillium, Fusarium were isolated from the soil of forest plots polluted with heavy metals, while most *Penicillium* species are considered as ubiquitous, opportunistic saprophytes able to grow in almost any environments with mineral salts (Gadd, 2008). Major differences among the species in terms of both numbers of spores and tolerance to metals suggest that fungi follow different strategies to establish symbiosis and probably *Aspergillus* sps. was preferentially found in soil samples with the differences in functioning (Bever *et.al.,* 1996). Rao *et.al.,* 1987, while studying *Rhizosphere mycoflora* found that certain species like *Aspergillus* showed dominance during the particular time of the year (Rao *et.al.,* 1987). As a common member of the microbial communities found in soils, *Aspergillus niger* plays a significant role in the global carbon cycle. *Mucor sp.* and their abundance can be attributed to their profuse occurrence in soil manure, fruits, vegetables and sturdy food (Pelczar, 2003).*Geotrichum candidum* has been isolated from highway soils of Agra City (Srivastava, 2001). Soil fungi are involved in numerous activities related to nutrient cycling, plant growth and plant health (Pratt, 2008). These include decomposition of organic matter with release of soluble nutrients, solubilization of nutrients from minerals, translocation of elements and nutrients within the soil profile and from soil to plants (Frey *et.al.,* 2003). Therefore, Plant microbe interactions may thus be considered beneficial, neutral or harmful to the plant, depending on the specific microorganisms and plant involved and on the prevailing environmental conditions (Bais*et.al.,* 2004).

Conclusion

Thus the present studies indicated the role of various ecological factors, stress due to presence of SWP in the soil samples investigated, interaction between individual selected plant species and its rhizosphere fungal community ultimately decided the existence, survival of fungal isolates, in various seasons. Some of them i.e. *Aspergillus niger, Absidia glauca, Rhizopus nigricans* and *Trichoderma koningi* are recognized as pollution indicators. Environmental contaminants are widely distributed in soils, there by having effect on the trophic chain, plants animals and man. These pollutants can remain in soil for a longtime and can adverse effect on microbial communities (Sokhn *et.al.,* 2001). Soil fungi are good environmental quality indicators. Since they are capable of survival soil pollutants from their local environment, their survival can indicate the degree of disturbances obtained from polluted environment. Before we can address how changes in microbial community structure

influences ecosystem functions, there is a need for reliable and accurate mechanism of studying soil microorganisms.

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